Aunt Cathy's Guide to: **Sanford Medical Center** 5-16

Nutrition Support of Iron Deficiency

 Aunt Cathy

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Iron deficiency can result in:

- **Poor ability to deliver oxygen to the body**
- **Loss of energy**
- **Poor ability to concentrate**
- **Impaired growth and mental development in children**
- **Impaired clearance from the body of potentially toxic substances**
- **Difficulty establishing a pregnancy**
- **Impaired carnitine production, and many other problems**

Iron deficiency can be quite common and it can be caused by a variety of factors. It may be related to:

- **Diets that provide poor amounts of iron or iron in forms that are poorly absorbed,** or which are high in substances that impair absorption.

- **Abnormal iron losses**, such as hemorrhage, heavy menstrual periods, or losses related to childbirth or surgery.

- **Conditions that impair iron absorption**, such as **Cystic Fibrosis**, or intestinal diseases like **Crohn's Disease**, **Inflammatory Bowel Disease** or **Celiac Disease**

- "**Bariatric surgery**" for weight loss is also associated with significant iron deficiency. In many parts of the world, people commonly have severe iron deficiency because of **intestinal parasites**.

- **Conditions that increase requirements**, (such as rapid growth of tissues during pregnancy, infancy or childhood,) can result in inadequacy when the usually adequate intake of iron is not enough to meet all the increased iron needs.

A Cautionary Note:

Iron deficiency is NOT ALWAYS the cause of anemia.

There are other situations that affect iron or red blood cell metabolism (such as deficiency of the nutrients needed as tools for iron metabolism (such as copper, or vitamins C, B6, B12, and folic acid.)

There are conditions that result in a short half-life of red blood cells (such as Sickle Cell Anemia and Thalassemia) which can result in low red blood cells but can also result in excessive tissue accumulation of iron from necessary therapeutic blood transfusions. In these conditions giving additional dietary or supplemental iron will certainly not solve the anemia problem, and it can actually be detrimental.

Surprisingly, even a **genetic condition that results in excessive iron absorption and iron overload (hemochromatosis) can result in a low red blood cell level**. This is because the treatment for iron overload is phlebotomy (giving blood, as one does for blood donation.) However, the continued ability to therapeutically remove iron this way requires that red blood cells must be made, so poor intake of the nutrients <u>other</u> than iron involved in making red blood cells can result in

- inadequate red blood cell production,
- a state of anemia (low red cell number and the associated symptoms) and
- continuation of the unhealthy high iron stores because it limits the ability to continue phlebotomy for iron removal.

Chronic diseases like arthritis, and infections can also result in low hemoglobin measurements that look like iron deficiency anemia in the laboratory but inadequacy of iron is not the problem. This is called "the **anemia of chronic disease**." This kind of anemia will be addressed later in this paper.

Bottom line: inadequate iron intake is a common cause of anemia, and so that is the first place to investigate. But if providing generous absorbable iron does not correct it, it will not be helpful to just continue to give more and more iron. More detective work is in order in this case.

Now back to the major focus of this paper:

Solving the problem when iron inadequacy IS the problem

FOODS THAT ARE GENEROUS SOURCES OF WELL-ABSORBED IRON:

MEATS:

1. "Heme iron" vs "Inorganic iron" issues

Meats of all kinds contain iron in an especially absorbable form called "heme" iron. This is also called "**organic iron**." Absorption of organic iron is not affected by the presence or absence of certain other substances in foods the way plant iron is. **Iron in this form is about 20% absorbed.**

Twenty percent absorption does not sound very high, **but "inorganic iron" is much less well absorbed … only 2% absorbed, and often considerably less.** That is why this approach alone is often not very effective. **Inorganic iron is the kind in plants and in supplements with the word "ferrous" or "ferric" in them.** Ferrous sulfate and ferrous gluconate are examples you will see on most iron supplement labels.

An "organic iron" supplement that contains the well-absorbed "heme" form of iron is available though much less commonly used and it is much more expensive. It is called "heme iron polypeptide." However, if iron deficiency is not corrected by the usual inorganic iron supplements or diet changes, this can be a very helpful nutritional supplement. It is well absorbed, it does not compete with other substances for absorption, and it is better tolerated by many people than the inorganic iron supplements. The nature of these **inorganic iron "tolerance" issues will be discussed below**.

Like other nutrients, supplemental or dietary iron does no good at all if it is not absorbed into the bloodstream from the intestines. It just passes right out in the stools. **Ferrous sulfate, a very commonly used iron supplement product that is less than 2% absorbed. Some plant forms of iron in foods like spinach that naturally contain "oxalates" are only 0.025% absorbed!** This bit of information is not well known, however, and very common traditional nutrition advice still commonly given is to correct iron deficiency anemia by eating spinach. Spinach is a terrific food to include in your diet for many reasons, but it is NOT a terrific iron source … it contains iron but you don't get very much out of the spinach because it is also high in oxalates.

Often at the higher doses used to treat anemia, **inorganic iron supplements like ferrous sulfate can cause stools to turn a black color and they may also contribute to constipation**. Neither is an unmanageable problem – the color is not a problem, and the constipation can be addressed a variety of ways with certain helpful foods or by using a laxative.

However, the reality is that people often discontinue taking this form of supplement because of these problems. [Iron-poisoning of children is often because they got into the medicine cabinet and took a handful of the small but high-dose ferrous sulfate pills that some adult quit taking for just these reasons!] And of course, no iron supplements will solve an iron deficiency problem if a person doesn't take them.

2. "Meat Protein Factor"

In addition to being a generous source of absorbable iron, meat also has a special property of causing increased absorption of iron from the inorganic iron sources in the meal. In other words, the iron in chili beans will be much more easily absorbed if there is meat in the chili. This is called the "Meat Protein Factor" effect. It is not well understood how it works, but it clearly does increase absorption of inorganic iron in other foods and supplements, so it helps to further improve recovery from low iron stores.

3. Meat: Variable AMOUNT of Iron

The total AMOUNT of iron in different kinds of meat varies. Red meat is the highest in absorbable iron. Poultry and fish have much less iron than red meat, but what they have is still a much greater amount than what is found in plant foods, and it also much better absorbed than inorganic iron. Additionally, white meat chicken/turkey has less iron than dark meat. **Think of the iron content of meat as "color-coded" … darkest is highest and the lightest is lowest.** But all have the beneficial "Meat Protein Factor" effect described above, and because it is organic iron, the form of iron is well absorbed.

Of the different types of meat, liver is an extremely generous source of absorbable iron. This also includes foods made from liver like paté or liverwurst. Not surprisingly, the iron content of blood is high and it is in an absorbable "heme" form, so things like Scandinavian/ German "blood sausage," and "blood pudding" are rich in iron. This is not a universally popular choice, however.

(Helpful hint: if you are trying to eat liver for the iron it can provide, but you don't LIKE liver, it can be ground up and mixed in with hamburger to make chili or meatballs or meatloaf. You can add a lot of onions and spices to mask its presence.)

Foods That INCREASE Absorption of (Inorganic) Iron:

Acid Foods

Any acid substance, including vinegar, citric acid and vitamin C (ascorbic acid) can enhance iron absorption from sources of inorganic iron (the form of iron found in pills or plants, like ferrous sulfate.) Because of this, people with iron deficiency are often advised to take their iron supplement or iron fortified cereal with orange juice, or some other acidic beverage.

However, the size of the increase in absorption is not as great as many people think, so that intervention alone is not likely to be that helpful.

For example, as noted earlier, inorganic iron is generally only about 2% (or less) absorbed, with some forms being much less absorbable than that because of substances in some foods that interfere with absorption. For that reason, the "take with orange juice" effect is a much less important factor affecting iron absorption than the highly absorbable and generous heme iron found in meat (especially red meat and liver.)

Acidity and alkalinity do not affect absorption of organic iron, so there is no special iron-absorption benefit associated with eating liver with orange juice or dousing it with ketchup (a vinegar- containing food), although the latter may make it more palatable to some people.

Foods That DECREASE Absorption of (Inorganic) Iron:

As described above, the presence of acid and/or meat will contribute to improved absorption of inorganic iron. Other food substances can significantly impair absorption of inorganic iron but they have minimal effect on absorption of organic iron.

For example, the organic iron forms like "heme" iron are about 20% absorbed, which is at least ten times as well absorbed as any inorganic iron. In addition, the per cent of absorption of inorganic iron is much more likely to be negatively affected by other substances in a meal.

Dairy Foods

Dairy foods are notoriously poor sources of iron that also decrease absorption of the iron in plants and pills. That means that taking iron supplements with milk, or putting milk on iron-fortified cereal, or cheese on a sandwich can result in less of the iron present in the pill, cereal or bread being absorbed. This is one of the issues behind the phenomenon of iron deficiency anemia in infants and toddlers who have cow or goat milk in place of mother's milk or iron fortified formulas.

A Bit of History:

When I started working in nutrition this kind of iron deficiency anemia condition was common, and it was called **"cow's milk anemia."** It is much less common today because the WIC Program (Women, Infants and Children Supplemental Food Program) came along in the late 1970s and it has done a lot to prevent infants being fed cow's milk or goat's milk too early. Before WIC, babies in low-income families were commonly fed those low-iron milks much earlier than was recommended because of the relative cost of **iron-fortified infant formula**.

An even bigger thing WIC has done that has had a tremendous effect on reducing the incidence of cow's milk anemia is that they **promote and support breastfeeding**. The iron in human milk is in the form of lactoferrin, and it is extremely well-absorbed. Absorption has been described as between 20-50% absorption, which is WAY better than the absorption of iron in formula or cereal even if orange juice is fed at the same time.

Another contributor to "cow's milk anemia" in toddlers is drinking quite a lot of milk, which serves to displace other foods that are good sources of iron. This is in addition to the role of cow's milk in actually impairing iron absorption from those foods.

Not surprisingly, this effect is most likely seen in children who also do not eat much meat (which would be unaffected by milk consumption) and who also do not take a multivitamin with minerals, which would at least have provided a higher amount of inorganic iron plus vitamin C in the same tablet.

Tea

Tea contains "tannins," plant substances that bind iron very well in the intestines and significantly reduces its absorbability. This effect is so marked that tea is the one food shown to be interfere with iron absorption enough to be helpful for people who have a serious genetic condition called hemochromatosis, a problem that causes them to absorbing way too much iron. And, as seen before, the consumption of tea has the most marked effect in decreasing absorption of inorganic iron compared with meat (organic) iron.

Here is an example of a clinical trial showing the effect of regular tea drinking on absorption of iron even among people with hemochromatosis which causes dangerously high iron accumulation (Gut. 1998;43(5):699-704.):

"A significant reduction in iron absorption was observed when the test meal was accompanied by drinks of tea instead of water. In the tea drinking group, the increase in storage iron was reduced by about one third compared with that of the control group."

Note that Hemochromatosis is a very dangerous condition, and it is now known to be much more common than previously thought. However, it is often unrecognized until it has caused serious injury.

For information on nutrition factors that can be helpful in this condition that causes excessive iron absorption, please see my paper "Aunt Cathy's Guide to Nutrition: Nutrition Support of Hemochromatosis Therapy."

Bottom line, tea has many other excellent healthful properties, but for people with iron deficiency anemia it is important to remember that helping them to improve iron status is <u>not</u> one of them.

Leafy Greens

Many leafy foods like spinach contain "**oxalates**" that bind up iron in the intestinal tract and make it too big a molecule to be absorbed well. This is true even though the iron and vitamin C content are generous. Some green plants like broccoli do <u>not</u> have oxalates and so their iron is better absorbed.

As noted before, leafy green plants are extremely nutritious foods and a very important part of a healthy diet. They provide **lutein**… a potent antioxidant that is a green pigment with a special role in preventing or slowing the development of macular degeneration (the #2 cause of blindness in America.)

Dark leafy greens also provide **vitamin K**, a nutrient now known to be critical for prevention of osteoporosis and calcification of arteries but found to be inadequate in the diets of many people. A generous amount of many other nutrients are also provided in these foods. **So <u>do</u> eat these foods for <u>many</u> reasons …. just don't rely on the oxalate-containing ones to solve the problem if a person is iron deficient.**

For information on nutrition factors that are provided by dark leafy greens, please see my paper "Aunt Cathy's Guide to Nutrition: Vitamin K" and "Aunt Cathy's Guide to Nutrition: My Top Five Easy Ways to Improve Your Family's Health."

Bran

The bran is the fibrous coating on grains. Bran contains "**phytates**" which impair iron absorption as tannins and oxalates do. For that reason, taking a bowl of iron-fortified bran cereal in milk along with a cup of tea is not the best way to get inorganic iron where you want it to go. Some grains naturally contain less phytate than others, but it is still an issue. Some grains (like "teff") are used more commonly in other parts of the world, and they are especially high in phytates. People's absorption of inorganic iron is greatly affected.

Eggs

Interestingly, although in the 1950s egg yolk used to be fed to infants as an iron source, the form of iron in eggs has been found to be poorly absorbed. Eggs are an excellent source of protein (the protein in one egg is like the amount in 1 ounce of meat) and other beneficial nutrients as well such as choline and biotin in particular. The egg white has most of the protein (6 of the 7 grams) and essentially none of the iron at all. Nearly all of the iron is in the yolk. **So eggs are still a terrific food, but not a good iron source.**

Iron-Fortified Foods

Iron "fortification" involves adding inorganic iron to foods that would not usually have iron, such as milk-based infant formulas or similar "nutrition beverages" for adults or children. **"Fortified"** also can mean that the iron (or another nutrient) was added to achieve a level higher than would naturally be in the food.

"Total"-type cereals are an example: it is fortified to provide **18 mg of inorganic iron per cup compared with 4.5 mg of inorganic iron in a cup of a similar but unfortified whole wheat cereal like regular wheat flakes.**

"Enrichment" means that a nutrient was removed by processing but then it was added back to the level it contained before processing. In America, iron is added back to refined grains. The available iron naturally in the grains is in the "germ" part of the grain that is lost when grains are refined. Unfortunately, we do not add back any other minerals; only iron and three B vitamins are added back (B1, B2 and B3.) That is all … no magnesium, no chromium, no vitamin E, etc.

This is one of the reasons why "**whole grain" products (containing the germ and bran) are nutritionally superior to enriched grains.**

[In 1998, processed grains products, whole or enriched, began to have the B vitamin "folic acid" added to improve the folic acid status of Americans. This was food "fortification"… a nutrient was added that was not there very much naturally.

This nutrient addition resulted in a 50% drop in the rate of certain birth defects like spina bifida, and also a drop of 10-15% in stroke rates across America. Assuring adequacy of micronutrients can be a very powerful Public Health tool!]

The iron content of commercial cereals can be quite variable, depending on the enrichment or fortification of the product. For example, "Quick" iron-fortified cream-of-wheat has over 15 mg of (inorganic) iron per cup, but unfortified cream-of-wheat or oatmeal only has about 2 mg.

Foods that have had iron added will indicate that they are fortified or enriched with iron if you check the label. The words "ferrous" or "ferric" in the ingredient list is an indication of inorganic iron being added.

Some Potentially Useful (and Important) Nutrition Teaching Tools:

The removal of so many of the nutrients in grain when they are "**enriched**," and the suggestion from this term that the grain product is made to be more nutritious than before has caused considerable confusion. It has also contributed to common nutrition problems in America with major consequences. These include a poor intake of magnesium and chromium, which contributes to diabetes and several other serious conditions.

For that reason, I teach my clients to **think of "EN-riched" as "UN-riched"** because so many nutrients are removed and not added back. Instead, we should **include more "Baby Plants"** in our diets, [seeds, nuts, legumes (e.g. beans, peas, peanuts and lentils) and the germ part of whole grains. Those baby plants are loaded with good nutrition.]

For more on this please see my other papers "Aunt Cathy's Guide to Nutrition: My Top Five Easy Ways to Improve Your Family's Health," "Aunt Cathy's Guide to Nutrition: Magnesium," "Aunt Cathy's Guide to Nutrition: Chromium," and "Aunt Cathy's Guide to Nutrition: OTHER Nutrition Issues in Diabetes."

The amount of iron contained naturally in some other foods

Legumes (like lima beans, chili beans, lentils, peas and peanuts) have 5-6 mg of iron per cup, but vegetables like carrots have only about 1 mg. (But I still want you to eat your carrots for reasons other than iron content. ☺)

Prune juice contains quite a lot of iron (over 9 mg per cup compared with about 1 mg per cup of other fruit juices) and it naturally contains some other substances that help one avoid the constipation issues. Absorbability of the iron has not been well studied, however.

Iron and Zinc Status and

General Iron and Zinc Content Chart of Food

The chart that follows shows the iron and zinc content of a number of foods and some factors described earlier that affect absorption of both minerals.

Two Important Points:

1. **As you can see on the chart, the foods highest in absorbable iron tend to also be highest in absorbable zinc, and vice versa.**

2. **Iron deficiency is the <u>most often recognized nutrient deficiency</u> in the USA, but that is generally because <u>it is the only one we actually look for</u> by easily checking hemoglobin levels.**

So unless the person is anemic because of actual blood loss, a person who is found to be iron deficient and living in our "iron fortified/enriched" world could easily have unrecognized poor zinc status as well.

Happily, zinc inadequacy is similarly best corrected by foods that also are best at correcting iron deficiency, so the recommendations discussed above for improving iron status via food sources will usually address both issues.

That is NOT the case if a food is "fortified" with iron (because they do not fortify with zinc as well.) Similarly, products like a "multivitamins with iron" or plain iron tablets or drops will not address a zinc inadequacy issue. Adequacy of both iron and zinc is critical.

For example, zinc status is important in **iron deficiency anemia** because inadequate zinc can also impair the production of red blood cells, even if there is plenty of iron available to make hemoglobin.

But zinc is important for much more than that. Zinc is involved in over 200 processes in the body, but it is much harder to evaluate with labs than iron is. For that reason it is very often not identified unless a nutrition history asking for details about meat consumption and supplement use, etc. is obtained. That does not happen often.

Impaired zinc status will interfere with the production of DNA … the genetic center of every cell … so adequacy of zinc is critical for **growth and wound healing**. It is also a key factor in the **functioning of the immune system** because production of T-cells is very zinc-dependent.

Breaking down **alcohol** also requires zinc because it is needed by the enzyme alcohol dehydrogenase. So combinations of alcohol exposure AND inadequate zinc status can make the all the damaging effects of alcohol abuse even more severe.

(For more on this please see my papers called
"Aunt Cathy's Guide to Nutrition: Why We Need to Assure Adequacy of Zinc"
and "Aunt Cathy's Guide to Nutrition: Nutrition and Fetal Alcohol Syndrome.")

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Zinc and Iron in Food

 Aunt Cathy

(Food groups in descending zinc-content order)

(from the series "How Am I Supposed to Remember All This Stuff?!")

Food	Amount	Zinc (mg)	Iron (mg)
Meats			
Oysters (cooked breaded & fried)	**3 oz**	**74.0**	**24.0**
Liver	3 oz	4.6	6.6
Beef	3 oz	4.0	3.0
Crab	½ cup	3.5	0.7
Lamb	3 oz	3.5	3.1
Turkey	3 oz	2.5	3.8
Pork	3 oz	2.4	2.7
Chicken	3 oz	2.0	1.0
Fish	3 oz	0.5	1.0
Legumes			
Dried beans (cooked)	½ cup	**1.0**	2.2-3.0
Split peas (cooked)	½ cup	1.0	2.2-3.0

Grains *

Fortified Cereals	1 cup	**1.5-4.0**	8.0 (4-18)
Wheat Germ	2 Tblsp	2.4	1.8
Brown Rice	1 cup	1.2	0.8
Oatmeal	1 cup	1.2	8 if fortified; 1.7 if not
Bran Flakes	1 cup	1.0	1.3
White Rice	1 cup	0.8	1.4
Bread (whole wheat)	1 slice	0.4	0.8
Bread (white)	1 slice	0.2	0.6

Nuts and Seeds

Pecans	¼ cup	**2.0**	0.6
Cashews	¼ cup	1.8	0.9
Sunflower Seeds	1 oz	0.5	1.1
Peanut Butter	2 Tblsp	0.9	0.6

Milk and Dairy Products*

Milk	1 cup	0.1	0.1
Swiss Cheese	1 oz	1.2	0.2
Cheddar or Mozzarella	1 oz	1.0	0.2
Yogurt	1 cup	1.2	0.1
Ice cream	1 cup	1.0	0.1

Fruit

Prune juice	4 oz	**0.3**	4.3
Dried apricots	½ cup	0.4	2.5
Prunes	5 med.	0.2	2.0
Raisins	¼ cup	0.2	1.3

Vegetables

Spinach, cooked*	½ cup	**0.7**	2.3
Peas	½ cup	1.0	1.6
Asparagus	2 cups	0.4	1.5

* **CB Note:** **Several substances present in foods <u>decrease absorption</u> of zinc and iron, especially of the inorganic forms:**

<u>Phytates</u> in whole grains and bran

<u>Tannins</u> in tea

<u>Oxalates</u> in certain leafy green vegetables

<u>Dairy products</u>